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Study on the Basic Problems of Safety Culture

Ahong He^a, Surui Xu^b, Gui Fu^{a,*}

^a*Faculty of Resources and Safety Engineering, China University of Mining & Technology, Beijing, 100083, China*

^b*Department of Safety Engineering, China Institute of Industrial Relations, Beijing, 100048, China*

Abstract

The concept of safety culture and its component elements and scales, and the relationship between safety culture and safety performance are the basic problems of the safety culture. In this paper the basic problems of safety culture on the basis of literature reviews were introduced. First, the concept of safety culture was defined as safety management items, making the border of safety culture construction clearly. Second, 32 safety culture elements were put forward by modifying, improving the study of Jim Stewart and combined with our national conditions and cultural background. It had been proved by experience that these elements are key factors influencing safety performance. Safety culture can be either qualitative or quantitative described, and the quantitative measurement can conducive to the improvement in the safety management and safety performance.

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1. Introduction

Judging from the modern accident causation chain, safety culture is the most important part of enterprise's safety management system, and it also provides direction to the organization structural design and operating procedures, and it will help organizations to prevent accidents and improve safety performance. Thus, more and more enterprises start to attach importance to the safety culture construction and actively carry out it, which are embodied in the systematic summary the previous work and relying on a certain external form to express and propaganda. Currently, the research on safety culture are conducted to its concept, component elements and scales, and the relationship between safety culture and safety performance. So this paper will start with the basic issues of safety culture and analysis the three areas mentioned above, then put forward views.

2. Concept of safety culture and its effect

Because of the different research perspectives, scopes and subjects, up to now, little consensus has been reached on the different aspects commonly associated with the concept within scientific discipline. According to the scope and characteristics of the definition, the study on the concept of safety culture at home and abroad in recent years can be divided into broad and narrow two aspects.

* Corresponding author. Tel.: 15201290516
E-mail address: heahong_sand@163.com

Broad concept of safety culture is derived from the definition of culture according to the dictionary, that is, safety culture is the sum of security-related material and spiritual wealth [1]. Typical theory is the theory of safety culture of four levels [2-5], what is considered that safety culture is the system of physical culture, institutional culture, behavior culture and spiritual culture. Two industrial standards [6-7], Directives for Developing Enterprise Safety Culture and Assessment Standards of Enterprise Safety Culture Developing, were enacted by the State Administration of Work Safety in 2008. Both of them are defined safety culture as “the sharing of safety values, attitudes, ethics and code of conduct” in a certain organization, which will provide the working direction for the safety culture construction. However, the required content of these two standards are far broader than that of it is in fact, and they shows a consistency only in some degree, that is, the meaning of safety culture are still more broadly. In addition, some literatures have showed that safety culture is a collection of safety problems [8-9], it apparently also broaden the definition of safety culture. So, there are two viewpoints can be summarized in general mentioned above, one can be read the knowledge of safety culture”, the other can be understood as “the aspects of the safety work”, and the first viewpoint could be contained by the second one. Thus, there would be only one meaning of safety culture, namely “the aspects of the safety work”. So the problem left is what safety culture contains is too broad, and no clear boundary, which made it difficult to grasp in the process of safety culture construction.

Different from the broad concept, the narrow definition of safety culture lays emphasis on some specific level, such as “spirit” or “behavior” level. It has been widely thought that safety culture can influence the spirit level, and it is the guidelines to decide behavior. Also some scholars agree that safety culture is basic assumption [10], it can affect the attitude and behavior of staffs [11], and it is the belief and value about health and safety problems [12]. Although concentration on some level, the research still do not point out what the safety culture is. That is because the terms, such as basic tacit, attitude, and belief and values and so on, seem too abstract to use, and it is difficult to reflect what the safety culture construction should contain and how to do it. Therefore, whether the broad safety culture or narrow, defining the concept of safety culture either too broad or too abstract, that makes the safety culture construction too difficult to grasp in actual.

As a result, we propose that safety culture is the sum of a series of concepts, that is, safety culture is the ideas of safety management. This definition is obtained through the analysis the narrow definition above, and it also can be seen as the limited result. Therefore, it may be called a limited definition of safety culture. Safety culture is the most important part of enterprise safety management system. As the most fundamental means, improving the quality and operation mode of safety management level could prevent major accidents, reduce accident rates and improve safety performance [13]. So safety culture has close relations to accident rate, affecting the level of accident rate.

3. Elements of safety culture and its scale

Currently, the research on the content and form of safety culture becomes diversified. On the Organization, building a safety culture is in fact promoting employee's understanding, implementation and application of safety culture. Specifically, safety culture is a rather vague terms. You can understand, implement, and apply it well until you have already understood the concept. In order to understand the concept of safety culture, academic research on its component element has begun. So far during the 32 years almost all the studies have focused on confirming the key elements of safety culture and developing the scales of those elements, and thus applied to the empirical study. The representative of the empirical study of the element of safety culture has listed below in table 1.

Through literature review, we can find there are two ways to do some research on elements of safety culture. One hand, it is by summarizing the elements used in the past through literature review; On the other hand, it is by questionnaires developed on the safety management elements to investigate the target organization's safety culture and then extracting safety culture elements on the basis of data. As for the research content, these issues with existing are exploratory research abroad more than systematic research, and little consensus has been reached on concept, dimension, and key elements and the mutual relationship [14]. Also nothing can prove the validity and effective of the dimension and elements.

Elements of safety culture differ from study to study. The reason can be reflected in the following three aspects. First, study samples were different. Thus, points on safety differently depending on several factors, especially the different industry, management focus, and potential problems. That led the structure of the elements not the same. Second, study methods were different. The tools involved mostly developed by researchers themselves. They developed their questionnaire by documentary, panel discussion, depth interviews and other methods. While the questionnaire is in itself controversial. As we all know, the questionnaire has the functional orientation. Its basic assumptions tend to benefit research purposes and the investigation contents may be limited by the number of dimensions. It is not complete and does not exist in practice. Judging from the content of the questionnaire, what survey is more abstract such as attitude, belief and value, all is limited to the current state or just past state, can only reflect certain aspects of the safety culture snapshot [15]. In the end, the understandings of connotation of safety culture were different. What is reflected in the extraction of variables, project planning, different screening, different expressions, and named with individual's randomness [16].

Table 1.The list of safety culture elements

Researchers	Elements
Zohar	leadership behavior, management expected role, subordinate unit risk assessment, leadership risk assessment [17]
Zhu Minhong	attitude to events, attitude to regulations and policies, internal management effectiveness, personnel skills [18]
Joan Harvey	management style and communication, commitment and participation, risk behavior, job satisfaction, avoid responsibility, risk awareness [19]
J.M.Stewart	management vision, commitment and promote, safety line management, participate in the activities of the safety and training, safety system and practical activities, safety organization structure and safety experts, safety equipment, safety consciousness [20]
Fang Dongping	safety attitude, management commitment, safety training and guidance, safety rule, influence of partners, report system, employees' risk-taking, safety resources, employee' safety ability, the degree of the staffs participation [21]
Yu Guangtao,Wang Erping	management commitment, safety abide, active spirit, leadership affect, safety involvement, emergency management, short-term performance, communication and coordination
State Administration of Work Safety	safety commitment, behavior standards and procedures, safety behavior incentive, safety information dissemination and communication, safety of autonomous learning and improvement, safety affairs involvement, audit and evaluation
M.N. Vinodkumar	management concerns on safety and action, employee's safety knowledge and abide by the safety, safety attitude, staffs involvement, working environment condition, emergency preparedness, safety priorities, risk identification [22]
Chen-Hua Wang	safety environment, safety rule, safety commitment, safety training, safety system, safety leadership, health activities, risk management, safety encouragement and punishment, performance measurement, contractor management, management of change, procurement management, safety communication, safety behavior [23]

Table 2. The elements of safety culture

number	key element	number	key element
1	Relative importance of safety	17	Safety council demands
2	Preventable extent of deaths and injuries	18	Formation way of safety system
3	Safety creates economic benefits	19	Consistent implementation of safety systems
4	Degree of safety into enterprise management	20	Types of investigated accidents
5	Safety depends mainly on safety awareness	21	Types of safety check
6	responsibility of work safety	22	Caring for injured workers
7	Awareness of safety input	23	Amateur safety management
8	Role of safety regulations	24	Treatment of safety performance
9	Safety values formation level	25	Facilities satisfaction
10	Degree of leaders' responsibility	26	Mastering of Safety performance
11	Understanding of the role of the safety sector	27	Safety performance and human resources
12	Degree of employee's participation in safety	28	Safety management of subsidiary and co-firms
13	Level of safety training needs	29	Function of safety organization
14	Degree of the department's safety responsibility	30	Work of safety department
15	Effects of community safety	31	Overall safety expectations
16	Function of safety management system	32	Emergency response capabilities

We believe that the elements from practice and used in practice are the most valuable, which also can improve enterprises' safety performance. J.M.Stewart came up with his safety culture element set based on enterprises' practices, his safety management model are composed of management vision, commitment and drive, line own ship of safety, involvement in safety activities and training, safety system and practices, safety organization and specialists, safety equipment and safety awareness, which first five are independent variables while the last two are dependent variables. Each variable has its items, with totally 25 items. In addition, we can basically confirm that there are 13 elements including in safety culture through the analysis, comparison, review literature, namely safety environment, safety rule, safety commitment, safety training, safety system, safety leadership, risk management, health activities, safety encouragement and punishment, performance measurement, contractor management, management of change, procurement management, safety communication, safety knowledge, worker participation, safety awareness and attitude, safety behavior. Taking these 13 elements and 25 items above for splitting, merging, removal, and combined with our national conditions and cultural

background, we have developed safety culture scale with 32 elements (Table 2). And those had been proved by experience that these elements are key factors influencing safety performance.

4. The relationship of safety culture and safety performance

From the viewpoint of management science, the performance is that organization makes full use of limited resources to achieve organizational goals. Thus, safety performance is that organization makes full use of limited resources to achieve organizational safety goals. Safety performance plays an important role in the organization that is because it is the external expression of safety assessment under the organizational operation. The relationships between safety culture and safety performance and whether there is simulative effect for safety performance have always been the topic for exploring. But it has been confirmed that the relationship between safety culture and safety performance is qualitative and quantitative both from theoretical study and empirical study.

Qualitative relationships between safety culture and safety performance has been confirmed. J.M.Stewart had published two articles discussed the relationship between safety culture and safety performance. One was about the safety performance of DuPont Canada company by describing the process from bad to excellent under the work of safety culture, at the same time with the safety performance at a higher level; the second was about International Rubber Factory with turning loss into gain under the 10 times improvement of safety culture level. K.J.Nielsen had found that excellent safety culture can effectively reduce accidents and improve safety performance through carrying out investigations between two homogeneous enterprises [24]. Cooper also had pointed out that there was correlation between safety culture and safety performance in his study [25]. Yu Xiubao also has found sufficient evidences from practice and theory supporting the viewpoint that safety culture is “subjective” which needs to have “objective” management approaches to take effect [26]. Only Xu Zhimin got the numerical relations by structural equation analysis, which path coefficient of safety culture on safety performance was 0.11, T value was 3.58, greater than 1.96 [27]. This suggests that safety culture has a positive correlation on safety performance, that is, the more mature safety culture is, the better to improve the safety performance.

Quantitative relationships between safety culture and safety performance has not yet been confirmed, but the results can know roughly. Fig1 is the variation in accident rates in North American pulp enterprise’s actual situation. As improving the safety culture elements, its safety culture level has increased, with the accident rate in the 5th year and 7th years clearly declining. “Safety value”, “safety creates economic benefits”, “staff involvement degree” and “accidents can be prevented” improved the most, respectively increased 50%,30%,12% and 10%. From that we can see that with the improvement of safety culture elements, accident rates had decreased significantly. There has a significant quantitative relationship between safety culture and safety performance.

In addition, a great deal of data about safety culture and safety performance was obtained based on series of widely working with companies since 2007. According to the data, Fig2 shows the relationship between the scores of safety culture and the safety performance [28]. Accordingly, we could broadly say that there is a roughly a linear relationship between safety culture and safety performance so far. That is to say, more higher levels of safety culture and less million tons death rate makes excellent safety performance. It provides ideas and guidelines for the quantitative studies between safety culture and safety performance; on the other hand, promote the enterprise to strengthen the construction of safety culture for realizing safety production.

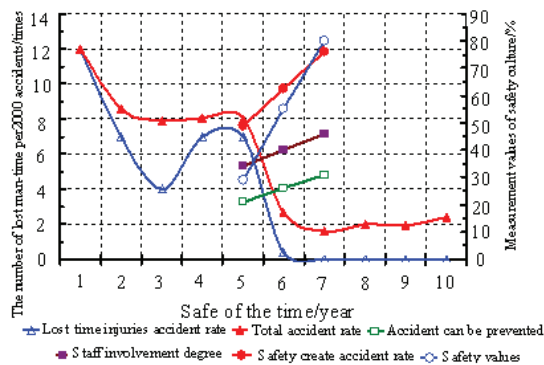


Fig 1. The relationship between safety culture Element scores and accident rates

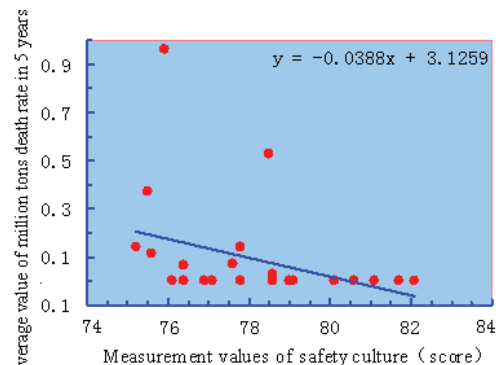


Fig 2. The relationship between safety Culture scores and safety performance

5. Conclusions

- The concept of safety culture and its component elements and scales, and the relationship between safety culture and safety performance are the basic problems of the safety culture.
- Through the narrow definition of safety culture, safety culture is the ideas of safety management, which clearly the scope of safety culture construction.
- By modifying, improving the study of Jim Stewart, 32 elements of safety culture were raised. And it had been proved by experience that these elements are key factors influencing safety performance.
- It is confirmed that the relationship between safety culture and safety performance is qualitative and quantitative both from theoretical study and empirical study.

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